PRODUCTION DEVELOPMENTS IN THE DAIRY INDUSTRY [1/]

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I appreciate the opportunity afforded me to participate in this meeting of the New England Research Council to discuss production developments in the dairy industry. Correspondence with your Chairman indicated that I am also to indicate future developments in dairying as I see them.

It is significant that your organization is examining the dairy industry in the Northeast. Dairying is an important part of the agriculture of this area and it contributes heavily to the food supply of the people.

Dairy Farming in an Adjustment Period

Dairying appears to be somewhat at a crossroads at the present time with the uncertainty of prices, the high cost of production, and the apparent huge surpluses of dairy products in government storage. We are well into an adjustment period which I believe is temporary and will straighten itself out as soon as we can get our people to take more milk and milk products. During June, dairy month, as well as in the months to come, increased efforts on the part of all of us interested in the dairy industry should be made to increase the consumption of dairy products. The American Dairy Association program sponsored by the industry itself is an important step in this direction.

Farmers on every hand are debating whether they should go into dairying or out of dairying, or whether they should increase the size of their herd or reduce it. It is my judgment that dairy farming has a bright future and that we should prepare now in this period of adjustment to take advantage of what the future has to offer. The dairy farmer's approach to the future should be on the basis of developing on his farm a program that is highly efficient in transforming farm-produced crops into high-quality, nutritious milk. High-quality milk will find a more ready market than low-quality milk, at prices that will encourage consumers to purchase it in increasing quantities. This program must be founded on modern cropping systems, on the development and maintenance of a high-producing herd, on the provision of an adequate low-cost feed supply based on forages, and on efficient management practices that provide an optimum environment for

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the producing herd with the least possible use of costly labor. The farmer should plan and operate more in terms of milk production per acre of land, per cow, and per man-hours of labor. Such a program should yield a net income, even in today's market, that will provide the kind of living the dairy farmer is entitled to enjoy.

Dairy Farming a Big Industry

The dairy industry has made great progress since the turn of the century. It has emerged from a "backyard" enterprise to perhaps the largest single farming industry from the standpoint of gross farm income. There are many reasons for this, the most important of which is an ever expanding, intelligent and discriminating consuming public that has learned to appreciate milk and its products as food. In terms of the future the brightest spot on the horizon is the rapidly expanding population, which by 1975 is expected to reach 205 million. The challenge to the dairy farmer and his cohorts who process and market milk and milk products is not only to hold the present level of consumption but to increase the part that milk plays in the food supply of our people.

National Milk Output a Result of Number of Cows and the Yield Per Cow

The annual output of milk is the result of two forces, the total number of milk cows and the yield per cow. Adjustments in these two forces enable the farmer to regulate his output of milk. at least to a certain degree, to meet changes in market needs. Table 1 shows the changes in cow numbers during the years 1940-1954. The number of cows of milking age has fluctuated from 27.8 to 23.4 million (18.8%) within this period. It built up to a high point of 27.8 million the late war year of 1945 and then decreased to a low of 23.4 million in 1952. The number of heifers and calves kept for replacements and the number of cows removed from herds have followed much the same trend, probably preceding it slightly. Since 1952 there is strong evidence of a significant increase in cow and heifer numbers and a decrease in the rate of removal or culling from herds.

Total milk production, as indicated in table 2, shows the same general trend as total number of cows except in 1953, when there was a very significant increase in total milk produced. On the other hand, the annual per-cow production of milk, with one or two exceptions, has shown a steady increase year by year. This to me is a very significant fact and indicates that we are making progress in improving this business of dairy farming and milk production. This reflects, I think, the research advances and the application of research results in the breeding, feeding, and management of our dairy cattle.

Per-Capita Production and Consumption Decreasing

Another fact that I believe should give us concern is the downward trend in the per-capita production of milk. As shown in table 2, the per-capita production of milk decreased steadily from 1945 to 1953. The heavy milk production in 1953 arrested the downward trend. Even so, per-capita production in 1953 was 120 pounds less than the high rate in 1942, a year when surpluses were not apparent. At the same time the per-capita consumption of milk and its products, which on a milk-equivalent basis increased from 807 pounds in 1940 to a high of 821 pounds in 1942, has steadily fallen to a low of 682 pounds in 1953. Per-capita consumption of fluid milk and cream increased from 331 pounds in 1940 to a high of 399 pounds in 1945 and then fell off to 352 pounds in 1953. Butter consumption has shown a rather steady decrease from 16.7 pounds in 1940 to about half that in 1953, while cheese, evaporated milk and dry skim milk have shown small but rather consistent increases.

These data show rather clearly some of the significant developments in the over-all dairy-industry picture and indicate, I believe, the need for all segments of the industry to bend their efforts to increase the consumption of dairy products to at least desirable historical levels and, if possible, beyond. These efforts must include lower costs of production, processing, and marketing, the production of higher quality products, the production of a greater variety of dairy foods having greater consumer appeal, and an increased educational effort to acquaint people with the economy and nutritional value of milk and its products.

Future Production Goals

Let's look for a moment at the future needs for milk and how these needs might be met. I indicated that by 1975 the population is expected to be about 205 million. How much milk will these people need and how will we get it? I have tried to make some predictions to answer these questions, as shown in table 3. I have chosen different figures for the per-capita production needed. The first, 680 pounds, is about the same as the per-capita consumption for 1953; the second, the per-capita consumption for 1947; the third, the per-capita consumption for 1942; and the fourth, which is about 60 pounds higher than the per-capita consumption for 1942 and the same as the per-capita production in 1942.

To provide these amounts for 205 million people it would require a total production respectively of 139.4, 155.8, 168.1, and 180.4 billion pounds. How many cows and what level of production would be required to meet these goals? To arrive at an aswer to these questions, I determined that the average increase in milk yield per cow from 1940 to 1953 was 63.5 pounds per year. If we assume that the same rate of increase continues,

the average cow in 1975 will average to produce 6,844 pounds. To provide the 680 pounds per-capita production it would require only 20.4 million milk cows. If the rate of increase is only half what it averaged in 1940-53, the average production would amount to 6,146 pounds and we would need 22.7 million milk cows. Similar figures are shown for per-capita rates of production of 760,820, and 880 pounds. We will not need a large expansion in cow numbers unless the rate of increase in production per cow lags, and then only if we require the materially higher per-capita production than current consumption levels call for.

Increase in Production Per Cow the Way to Meet Future Needs for Milk

I believe you will agree with me that the most logical and most efficient way to meet future production requirements is by increasing the rate of milk production per cow. Recent history shows that this can be done. Our average cows are producing far below the average DHIA cow (5,447 pounds compared with 9,200 pounds). All of the data that I have seen indicate that within limits high-producing cows are more profitable than low-producing cows. By keeping herds of high-producing cows on farms, a high output of milk per farm can be maintained with less cost for feed and labor. Modern methods of farming and increases in productivity of farm crops enable farmers to produce more milk per acre. The family farm unit can produce more milk and can even keep more cows per farm than was the case a few years ago. The size of herds has been increasing and probably will continue to do so in the future. This also makes for more efficient use of land resources, and for more efficient, lower cost milk production.

The reason dairy farmers have been able to make steady progress in the past is that they have been provided, from research and educational sources, the information needed to develop better cattle, to provide more adequate feed supplies, and to give them better opportunities to produce by creating more favorable environments. Progress in the future will be made through continuation of these desirable developments. But they will have to be adopted more widely and at an increasing rate. Furthermore, basic and applied research and education will have to be speeded up to provide the necessary new information to carry our production program to the desired heights.

Factors Contributing to Dairy Development

I want to review for you some of the important things that I believe have contributed importantly to the progress we have made and that will enable us to continue to advance in the future. First I want to discuss some points in relation to the improvement in the quality of dairy cattle through breeding. The production test has been the key to improvement because it has enabled farmers to obtain a measure of the abilities of cows in their herds. It serves as a basis for feeding and culling but also it affords a basis for selecting desirable breeding animals to produce replacements.

The DHIA Program

Production testing has been organized and made available to farmers through the cooperative Dairy-Herd-Improvement Association Program. This program has been a great force for the improvement of dairy cattle. While the program includes only about 5 percent of the dairy cattle, it serves as a great demonstration of good dairy practices, it serves as a source of production-tested breeding stock, and it leads the way to efficient dairy farming. The growth of the DHIA program is illustrated in table 4.

Breed Society Programs

The progressive programs of the several dairy breed registry associations, while they still include less than 5 percent of the dairy cattle, also have contributed importantly to the improvement in the quality of dairy cattle. The great majority of the bulls used (all of those used in the Artificial Breeding Associations) are registered in one of the breed association herd books. The growth in registration of animals in the important dairy breed associations is given in table 5.

Breeding Research

Breeding research has developed information for use by breeders to guide them in producing better cattle. Results of investigations on the relative merits of inbreeding, linebreeding, and outcrossing are available to guide farmers in selecting and breeding better dairy cattle. Typical results are shown in tables 6 and 7. The establishment of the sound principles of proved-sire breeding has provided most significant guidance to the breeder. Meritoriously-proved sires, those that have demonstrated by progeny testing in which the performance of the sire's daughters are compared with that of their dams that they transmit factors for high production, take much of the gamble out of breeding

better dairy cattle. Table 8 shows the results of proved-sire breeding.

Regional breeding-research projects now under way promise much additional needed information that will be invaluable to dairy farmers in developing dairy cattle that will be more productive and better adapted to particular regions. More attention will need to be given also to developing strains of cattle that convert feed, especially forage, to milk more efficiently.

Development of the Artificial-Breeding Program

The supply of meritoriously-proved sires is limited but the advent of artificial breeding makes the services of such sires and carefully selected unproved sires within the reach of all dairymen. The artificial-breeding program will prove to be the greatest force in the mass improvement of the Nation's dairy cattle. Coupled with the Nation-wide sire-proving program, which is conducted by the U. S. Department of Agriculture and the State colleges, and the breed associations' testing programs, which locate and identify meritorious transmitting sires, the artificial-breeding program selects and makes available to all dairymen the services of the best sires in the country. The artificial-breeding program, as shown in table 9, has had a phenominal growth and will do much to assist farmers in breeding the kind of cows they will need to efficiently provide the milk supply for the future. The development and use of frozen semen will aid further in spreading the influence of meritorious sires through more efficient use of the germ plasm they furnish.

Need for Milk More Suitable to Present-Day Markets

In the future more attention will be given by researchers to developing strains of cows that produce milk more nearly suitable to current market needs. Investigations are needed, and currently are being organized, to develop strains that produce milk of a higher solids-not-fat content in relation to fat.

Improvements in Feeding Practices

Along with the improvement in the producing abilities of the dairy cattle have come improvements in feeding practices. These advances have come about through the gradual development of knowledge of nutritional research. The discovery of the essential requirements of protein, minerals, and vitamins for growth, reproduction, and lactation has

enabled the dairyman to plan cropping programs and to furnish balanced feed supplies for the producing herd. The utilization of this knowledge through the DHIA program and by other means has been a great factor in increasing milk production. Yet, proper feeding or the lack of it, under average conditions is the factor, which, in my opinion, is yet most limiting milk production. Our cows on the average are not well enough fed to produce to their maximum abilities and this is one of the causes for the high cost of milk production.

Forages the Basis for Economical Dairy Rations

Feed accounts for 48 to 50 percent of the cost of milk production. By improving feeding practices milk production costs can be decreased. The feed supply usually is made up of forage and grains or concentrates. Forages are almost always provided from the home farm in the form of pasture, hay, and silage. Feed nutrients can be furnished at lower costs in forages than in concentrates, either homegrown or purchased. For this reason it is important to rely as much as possible on homegrown forages, and they should be provided in amounts that will insure maximum consumption. Forages vary considerably in quality. On the average, because of the cropping and harvesting methods used, they are rather low in quality. Cows will eat more dry matter and produce more milk when fed good-quality forage than when fed poor-quality forage. This is illustrated in table 10. When poor-quality forage is produced, the losses in nutrients are high and the resulting feed is of low nutritional value.

Good Pasture the Basic Feed

In recent years much interest has been focused on grassland farming, not only as a means of utilizing land resources properly but as a means of obtaining, by proper cultural management of forage crops, large amounts of nutrients at low costs. Pastures are beginning to come into prominence as the main sources of feed for about half the year and improved cultural and management practices, including supplemental irrigation, promote increased production and utilization. Modern machinery has taken much of the hard work out of harvesting forages and has enabled the farmer to get hay and silage into storage quicker.

Improvement in Methods of Harvesting Forages Needed

The problems connected with harvesting hay and silage have been given considerable attention but we have not yet effected very much improvement in the quality of these feeds. Research carried on at Beltsville in recent years has focused much attention on this problem. This work, for the first time, has shown the high losses in feed nutrients that result

from conventional methods of harvesting. These findings are summarized in figure 1 and table 11. They suggest that one way farmers can increase their forage feed supply, and also increase its value, is to reduce the losses that occur during harvesting and storage.

In recent years, as a result of these and many other findings, there has been a marked trend toward making grass silage instead of hay, as a means of putting up forage for winter feeding. The making of grass silage has increased more than tenfold in less than that number of years. The development of the barn-finishing method of curing hay, and also the artificial dehydration and pelleting of forage, has been advanced as a means of improving the quality and feeding value of hay.

Grass Silage Increasing in Importance

The problems of making grass silage in silos, trenches, and stacks, with various types of machines and by using various methods, is undergoing intensive study and practical trial use. The question is no longer "Shall I make grass silage" but "How shall I make it?" I think we can look forward to significant new developments on this method of harvesting forages to the end that the farmer will have a more dependable, higher quality feed.

It would appear, therefore, that in the future more of the milk supply should and will come from forages. It seems to me this offers the opportunity for the farmer to do a better job of feeding his cows, of lowering the cost of milk production and increasing his returns.

Past Increases in Production Largely Due to Heavier Grain Feeding

Now I should like to have you take a look with me at how the dairymen have been obtaining the steady increase in milk production per cow. In table 12 I show the average milk production per cow, the amount of concentrates fed per cow, the concentrates fed per 100 pounds of milk produced, and the milk-feed price ratio for each year from 1940 to 1953. Note that the rate of concentrate feeding and the amount of concentrates fed per 100 pounds of milk produced have gone up rather steadily along with milk yield. The extra nutrients fed in the concentrates more than made up for the nutrients in the extra milk produced or for the increase in milk yield. I conclude that forages played little or no role in this increased milk yield throughout these years. Note also that the number of pounds of concentrates a pound of milk would buy has generally decreased, especially in the last few years.

Trends in Northeast Dairy Farming

A report of a recent study by the U. S. Department of Agriculture, on commercial family-size dairy farms in the Northeast, gives some interesting information pertinent to the subject of this discussion. I have chosen some of the data from that report to illustrate a few points showing the trends of these dairy farmers in their operations from 1940 to 1951. Table 13 shows that the average size of the farm, the cropland used, the acreage in corn silage and in hay and open pasture, all increased as did the yield per acre of corn silage, grain, and hay. There is no apparent large shift to grassland crops, however.

Likewise, as shown in table 14, the size of the cow, calf, and heifer herd steadily increased as did the yield of milk per cow and per acre of land. I would judge that this was all accomplished with little or no additional labor. This no doubt is a reflection of the good markets that have prevailed during this period.

How Northeast Dairy Farmers Have Been Feeding Their Cows

In table 15 I have shown the rate of grain feeding per cow and per 100 pounds of milk. Like in table 12 these data show a rather steady increase in grain feeding. The increase was not as great for the amount of grain fed per cow but greater for the amount fed per 100 pounds of milk produced.

I have calculated the amount of total digestible nutrients (TDN) required for milk production and deducted the amount furnished by grain to obtain the percent of the TDN required for milk production that came from grain. This increased from 73 percent in 1940 to 86.7 percent in 1951. In other words, the forage fed maintained the cow and furnished only 13.3 percent of the nutrients for milk production in 1951. I also calculated (by difference) the average daily pounds of hay equivalent estimated as consumed per day by the average cow in these herds. This ranged from 20.5 pounds in 1940 to 19.2 pounds in 1951. This hay equivalent would be the forage consumed either as hay, silage, or pasturage adjusted to a hay basis. There was not much change over the years. However, this is a rather low rate of consumption for forage. On the basis of an 1,100-pound cow, this would be 1.86 to 1.75 pounds per day per 100 pounds.

Cows Will Eat More Good Forage

Research studies have shown that cows of similar size fed grain

at the rate that these cows were fed will consume 2 1/4 to 2 1/2 pounds daily of average-quality forage and from 2 1/2 to 2 3/4 pounds of high-quality forage per day per 100 pounds body weight. This would be from 25 to 30 pounds of hay or hay equivalent. These comparisons suggest that the dairy farmers in the Northeast who were included in these studies were not making the fullest possible use of forage. I am of the opinion that this is generally true throughout the country.

I am inclined to believe that dairymen have been depending largely on heavier grain feeding to obtain increases in milk production and that they could well afford to place more emphasis on forage as a means of lowering the cost of milk production. I am convinced that the opportunity for improving the dairymen's situation in the years to come lies, to a considerable degree, in providing more and better forage for their herds.

Better Calf Raising Methods Developed

We have seen a lot of new developments in the herd management field. Knowledge of the nutritional requirements of calves and growing heifers has made it possible to raise good replacements with fewer losses and with lower cost feeds. The addition of antibiotics and vitamins, etc., to calf starters and milk substitutes, in certain situations, has made it possible for dairymen to market more of the whole milk produced. Further advances are sure to come from the active research under way in this field.

Disease Control Gains

Likewise, the development of more knowledge of the causes and methods of preventing the occurrence of communicable diseases has made it possible to reduce losses from such maladies, yet we have a long way to go in this area. Increased research effort and more active participation in disease control programs are needed to cope with presently known and new diseases that continually trouble the herd owner.

More Infertility Studies Needed

Infertility of cattle, caused by disease organisms and by physiological disturbances, remains a troublesome problem. Regional research projects are under way which will produce new information on how to reduce the losses of cows from herds because of sterility and low fertility.

Chore Operations Becoming More Efficient

We have seen developments in the past 8 or 10 years that will make the job of taking care of dairy cattle more simple and less costly. The trend is toward the use of loose housing and the milking parlors, coupled with horizontal storage and movement of feeding and bedding, and the self feeding of hay and silage on dairy farms. These modernized procedures reduce labor and make for more efficient milk production. Reduction in the building and equipment costs for housing and caring for cattle has been occurring on many farms and this trend will continue. The hours of labor required to care for a dairy cow should and can be reduced. The milking machine was one of the first pieces of equipment that contributed to the saving of labor and it has been so universally adopted that more than 700,000 milking machine units are now in use on dairy farms. Along with this has come the increased use of the milking parlor and the use of the pipeline and bulk storage systems of milking and holding milk on the farm. These modern methods make for faster, more efficient milking, and the production of a higher quality of milk on the dairy farm.

The mechanical removal of manure is another development that is coming in to reduce the chore operation. All of these modern conveniences, while they increase to some extent the investment in equipment, contribute to a more efficient farming operation. Their use to some extent depends on a fairly large size operation and will no doubt tend to increase the size of herds maintained on farms.

Summary

In summary, I am sure we can say that the dairy farmers of the U. S. can take pride in the progress they have made in the past. They have done a magnificant job of advancing the welfare of the people as well as themselves. Under a variety of difficult and emergency conditions they have utilized the resources available to provide the people with plentiful supplies of nature's best food. In no other country is there to be found a better and more dependable supply of milk and dairy products. Dairy farmers have used the soil resources as well as, or better than, any other class of farmers. They have lent stability to the American agricultural industry.

Dairy farmers can look forward with confidence to the future. Their most important task is to continue to provide ample supplies of

good milk at prices as low as possible to encourage consumption. They must intensify their efforts to promote the consumption of the highly nutritious product they produce. They must continually improve their methods to bring about more efficient production so they can market more milk per acre of land, per cow, and per hour of labor. They must adopt at accelerated rates the new methods and ideas developed from research and experimentation. The efficient dairy farmer in the future can have a rewarding mode of life, as good as or better than he has had in the past.

Table 1.- Number of dairy animals on farms in the United States, 1940-54

Year	Number of dairy animals by classes			Cows and heifers removed from herds
	Cows 2 years old and over	Heifers 1 to 2 years old	Calves under 1 year old	
	Million	Million	Million	Million
1940	24.9	5.5	6.0	5.0
1941	25.4	5.7	6.2	4.8
1942	26.3	5.9	6.6	5.1
1943	27.1	6.1	7.0	5.5
1944	27.7	6.4	7.2	6.3
1945	27.8	6.3	6.8	7.6
1946	26.5	5.8	6.3	6.4
1947	25.8	5.5	6.3	6.8
1948	24.6	5.6	6.0	6.3
1949	23.9	5.3	6.1	5.3
1950	23.8	5.4	6.2	5.5
1951	23.9	5.5	6.4	5.9
1952	23.4	5.7	6.5	5.0
1953	24.1	6.0	6.7	5.3
1954	24.7	6.0	6.8	---

Table 2.- Milk production, total per cow per year and per capita in the United States, 1940-53

Year	Total production	Yield per cow	Per capita production
	Billion pounds	Pounds	Pounds
1940	109.4	4,622	828
1941	115.1	4,738	863
1942	118.3	4,736	879
1943	117.0	4,598	856
1944	117.0	4,572	846
1945	119.8	4,787	856
1946	117.7	4,886	832
1947	116.8	5,007	810
1948	112.7	5,004	768
1949	116.1	5,272	778
1950	116.6	5,314	769
1951	114.8	5,313	744
1952	115.2	5,329	734
1953	121.2	5,447	759

Table 3.- Rates of increase in milk production, total production and number of cows needed to meet certain per capita production goals in 1975 (based on a human population of 205 million people)

Per capita production goal 1975	Total milk production required	Rate of increase per cow per year (1954-75)	Average production per cow	Milk cows needed
	Billion pounds	Pounds	Pounds	Million
680	139.4	63.5	6,844	20.4
	139.4	31.8	6,146	22.7
760	155.8	63.5	6,844	22.8
	155.8	31.8	6,146	25.3
820	168.1	63.5	6,844	24.5
	168.1	31.8	6,146	27.3
880	180.4	63.5	6,844	26.4
	180.4	31.8	6,146	29.3

Table 4.- Growth of dairy-herd-improvement-association work in the United States, 1906-54

Year	Associations	Herds on test	Cows on test	Average production of cows on test		
				Milk	Test	Butterfat
	Number	Number	Number	Pounds	Percent	Pounds
1906	1	31	239	-----	---	215
1907	4	-----	1,606	-----	---	220
1908	6	-----	3,921	-----	---	---
1909	25	-----	11,921	-----	---	---
1910	40	-----	1/ 25,000	-----	---	---
1911	64	-----	1/ 40,000	-----	---	---
1912	82	-----	1/ 43,000	-----	---	---
1913	100	-----	47,150	-----	---	---
1914	163	-----	73,280	-----	---	---
1915	211	----	105,526	-----	---	---
1916	346	-----	150,677	-----	---	---
1917	459	11,720	216,831	-----	---	----
1918	353	9,778	172,518	-----	---	---
1919	385	10,000	167,313	-----	---	---
1920	468	11,948	203,472	-----	---	247
1921	452	11,209	193,928	-----	---	---
1922	513	12,508	215,321	-----	---	---
1923	627	16,356	277,010	-----	---	---
1924 2/	---	-----	-----	-----	---	---
1925	732	18,677	307,073	-----	---	284
1926	777	19,540	327,653	7,331	4.0	290
1927	837	21,128	362,014	7,411	4.0	293
1928	947	23,327	414,891	7,476	4.0	296
1929	1,090	26,182	465,804	7,498	4.0	298
1930	1,143	27,888	507,549	7,642	4.0	303
1931	1,112	26,308	510,714	7,812	3.9	306
1932	1,005	20,351	427,044	7,858	3.9	310
1933	881	15,447	358,501	7,849	4.0	313
1934	793	13,694	325,837	8,015	4.0	322
1935	809	15,573	364,218	7,977	4.0	322
1936	876	17,344	404,412	7,912	4.0	319
1937	992	20,772	496,562	7,923	4.0	320
1938	1,106	23,701	558,993	7,831	4.0	317
1939	1,228	25,949	625,284	7,977	4.1	323
1940	1,300	27,948	676,141	8,133	4.1	331
1941	1,383	31,381	763,502	8,225	4.1	335
1942	1,421	32,957	816,117	8,323	4.1	339
1943	1,057	24,155	616,972	8,325	4.1	338
1944	954	20,825	561,587	8,296	4.1	336
1945	949	21,254	577,200	8,592	4.0	346
1946	1,124	23,331	627,878	8,635	4.0	349
1947	1,426	28,812	775,546	8,638	4.0	348
1948	1,668	33,274	886,129	8,675	4.0	350
1949	1,787	35,851	943,939	8,907	4.0	359
1950	1,973	40,100	1,088,872	9,172	4.0	370
1951	2,143	42,949	1,186,615	9,195	4.0	370
1952	2,109	40,105	1,166,297	9,192	4.0	366
1953	2,151	40,983	1,226,588	-----	---	---
1954	2,175	41,254	1,311,698	-----	---	---

1/ Estimated.

2/ Date for collecting data changed in 1924 from July 1 to January 1.

Table 5.- Annual registrations of dairy cattle in the United States, by breeds, 1940-53

Year	Holstein	Guernsey	Jersey	Ayrshire	Brown Swiss
	Number	Number	Number	Number	Number
1940	145,423	53,980	49,875	16,237	11,161
1941	102,803	57,796	76,121	17,014	12,819
1942	106,624	66,280	56,531	17,713	14,019
1943	111,197	72,521	45,595	20,027	16,270
1944	122,910	74,231	56,471	20,755	17,695
1945	113,446	77,300	53,900	21,517	18,119
1946	169,338	79,578	49,271	22,169	22,108
1947	152,739	86,406	60,927	30,046	22,469
1948	168,338	96,895	69,683	26,113	22,625
1949	177,925	89,106	65,973	26,317	20,988
1950	184,246	94,901	68,795	24,236	22,342
1951	191,638	93,629	68,652	25,463	24,115
1952	189,690	113,909	73,990	23,208	23,099
1953	1/ 161,978	78,331	80,685	20,522	18,672

1/ 10 months.

Table 6.- Comparative production of outbred, linebred, and inbred Holstein cows in the Beltsville herd 1/

System of breeding	Daughter-dam pair	Daughters' production			Dams' production		
		Milk	Butterfat		Milk	Butterfat	
	Number	Pounds	Percent	Pounds	Pounds	Percent	Pounds
Outbreeding	185	20,688	3.79	783	20,276	3.74	758
Linebreeding	51	20,067	3.69	741	20,074	3.66	737
Inbreeding	65	18,476	3.94	728	20,105	3.80	767

1/ Average based on highest record of each cow, made on 3 milkings a day for 365 days, calculated to maturity.

Table 7.- Average production of the foundation cows and their crossbred descendants in the Beltsville crossbreeding experiment

Generation	Cows tested	Average calving age	Production 1/			Mature-equivalent	
			Milk	Butterfat		Milk	Fat
	Number	Yr.-Mo.	Pounds	Percent	Pounds	Pounds	Pounds
Foundation cows	55	2 6	10,540	4.55	455	13,799	594
2-breed crosses	55	2 2	13,039	4.53	586	17,811	799
3-breed crosses	58	2 2	13,361	4.44	588	18,240	807
Progeny of 3-breed crosses	23	2 3	13,174	4.58	600	17,764	800

1/ Actual production at ages given, on 3 milkings a day for 365 days.

Table 8.- Influence of proved-sire system of breeding on production of 7 generations of offspring in Beltsville Holstein herd 1/

Group	Cows	Milk	Butterfat	
	Number	Pounds	Percent	Pounds
Foundation cows	34	19,966	3.40	678
Daughters by:				
Sire No. 1	33	19,059	3.49	663
Sire No. 2	31	19,759	3.57	705
Sire No. 3 2/	9	16,504	3.95	659
Sire No. 4	5	20,944	3.78	790
Sire No. 5	52	21,223	3.99	845
Sire No. 6	47	23,122	3.84	885
Sire No. 7 3/	55	21,290	4.00	850

1/ Based on highest record of each cow, made on 3 milkings a day for 365 days, calculated to maturity.

2/ Two of the nine daughters were abnormal and made extremely low records, which are included.

3/ The data on this sire are not yet completed.

Table 9.- Growth of artificial-breeding organization work in the United States, 1939-54

Year	Organizations (Units)	Herds	Cows bred	Sires in service			Dam-daughter production data for proved sires				Dows bred per sire
				Total sires	Proved sires		Dams		Daughters		
							Milk	Fat	Milk	Fat	
	Number	Number	Number	Number	Number	Percent	Pounds	Pounds	Pounds	Pounds	Number
1939----	7	646	7,539*	33	-	-	-	-	-	-	228
1940----	30	2,971	33,977*	138	-	-	-	-	-	-	246
1941----	42	5,997	70,751*	237	-	-	-	-	-	-	299
1942----	73	12,118	112,788*	412	-	-	-	-	-	-	274
1943----	99	23,448	182,524*	574	135	23.5	9,559	387	10,155	419	318
1944----	95	28,627	218,070*	657	129	19.6	9,965	391	10,490	421	332
1945----	195	43,998	360,732*	729	147	20.2	9,629	387	10,488	428	495
1946----	336	73,293	537,376	900	209	23.2	10,270	401	10,741	428	597
1947----	608	140,571	1,184,168	1,453	235	23.1	10,099	405	10,580	430	815
1948----	963	224,493	1,713,581	1,745	426	24.4	10,161	407	10,576	433	982
1949----	1,263	316,177	2,091,175	1,940	514	26.5	10,157	412	10,499	436	1,078
1950----	1,460	372,968	2,619,555	2,104	559	26.6	10,236	415	10,734	444	1,245
1951----	1,653	467,224	3,509,573	2,187	634	29.0	10,267	419	11,009	459	1,605
1952----	1,648	543,397	4,295,243	2,324	688	29.6	10,310	422	11,210	471	1,848
1953----	1,623	571,921	4,845,222	2,598	953	36.7	10,375	429	11,176	473	1,865
1954----	1,432	606,997	-	2,661	-	-	-	-	-	-	-

*Prior to 1946 cows were reported only on the basis of enrollment.

Table 10.- Relation of grade, physical, and chemical characteristics of hay to the level of consumption and milk yield by dairy cows at Beltsville, Md. 1/

Kind and grade of hay	Leaf content	Protein content	Fiber content	Daily dry-matter consumption per cow	Daily milk yield per cow
	Percent	Percent	Percent	Pounds	Pounds
U.S. No. 1 alfalfa----	50	18.6	21.2	36.2	42.6
U.S. No. 2 alfalfa----	29	14.6	32.4	28.2	36.7

1/ Unpublished data.

Table 11.- Losses of dry matter and feed nutrients from forages harvested and stored in different ways

Kind of forage	Dry matter	Protein	Carotene	Total digestible nutrients	Net energy
	Percent	Percent	Percent	Percent	Percent
Field-cured hay:					
Rained on-------	36.6	46.1	99.1	42.1	47.2
No rain---------	21.0	27.7	96.8	25.5	29.6
Barn-dried hay----	19.0	24.0	93.7	24.0	28.6
Silage----------	16.8	16.9	80.9	19.5	19.5

Table 12.- Milk yield, concentrates fed per cow, concentrates fed per 100 pounds of milk and milk price-feed price ratio, United States, 1940-53

Year	Milk yield	Concentrates fed	Concentrates fed per 100 pounds milk	Milk-feed price ratio
	Pounds	Pounds	Pounds	
1940	4,622	1,275	27.6	1.29
1941	4,738	1,335	27.5	1.39
1942	4,736	1,380	29.1	1.32
1943	4,598	1,410	30.7	1.35
1944	4,572	1,392	30.5	1.38
1945	4,787	1,503	31.4	1.42
1946	4,886	1,490	30.5	1.38
1947	5,007	1,509	30.1	1.18
1948	5,044	1,616	32.0	1.26
1949	5,272	1,640	31.1	1.28
1950	5,314	1,629	30.6	1.24
1951	5,313	1,605	30.2	1.29
1952	5,328	1,628	30.6	1.28
1953	5,447	1,676	30.8	1.25

Table 13.- Farm size and production of feed on family-size commercial dairy farms in the Northeast 1/

Year	Acreage in farm land			Acreage harvested			Yield per acre		
	Total	Cropland	Open pasture	Corn silage	Small grains	Hay	Corn silage	Small grains	Hay
							Tons	Tons	Tons
1940	177	67	66	6.7	14.5	42.3	14.5	0.62	1.5
1941	178	67	66	6.8	14.3	42.3	14.3	.53	1.1
1942	179	68	66	6.8	14.2	43.4	14.2	.64	1.5
1943	182	72	66	6.8	11.7	46.5	11.7	.38	1.6
1944	183	71	67	7.4	10.8	47.5	10.8	.57	1.4
1945	185	76	67	6.9	14.0	48.2	14.0	.56	1.6
1946	186	75	68	7.2	14.3	47.6	14.3	.66	1.6
1947	188	74	69	7.1	12.3	46.0	12.3	.54	1.6
1948	190	75	70	8.0	15.6	46.5	15.6	.70	1.6
1949	190	77	70	8.5	15.6	45.5	15.6	.58	1.3
1950	191	78	70	8.7	16.3	45.5	16.3	.74	1.6
1951	193	79	72	8.8	16.6	46.0	16.6	.75	1.7

1/ Adapted from U. S. Dept. Agr. AIB 86, Changes in dairy farming in the Northeast, 1930-51. Issued in 1952.

Table 14.- Number of dairy cattle, yield per cow, and yield per acre on family-size commercial dairy farms in the Northeast 1/

Year	Dairy stock			Milk yield per cow	Milk yield per acre
	Cows of milking age	Heifers over 1 year	Calves		
	Number	Number	Number	Pounds	Pounds
1940	18.3	5.4	4.4	6,101	6,345
1941	18.7	5.3	4.4	6,290	6,607
1942	18.8	5.3	4.2	6,442	6,804
1943	19.1	5.0	4.5	6,174	6,550
1944	19.7	5.4	5.1	6,089	6,721
1945	20.7	6.1	4.7	6,326	7,076
1946	20.8	5.6	4.5	6,259	7,000
1947	20.9	5.4	4.8	6,588	7,270
1948	20.6	5.8	5.1	6,491	7,008
1949	20.8	6.1	5.2	6,715	7,384
1950	21.1	6.2	5.4	6,861	7,618
1951	21.2	6.5	5.4	6,900	7,653

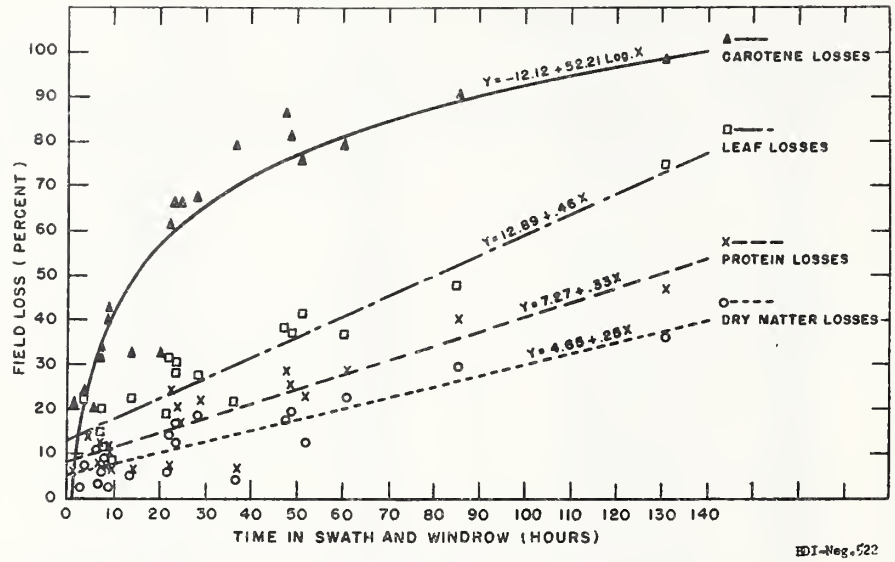
1/ Adapted from U. S. Dept. Agr. AIB 86, Changes in dairy farming in the Northeast, 1930-51. Issued in 1952.

Table 15.- Grain and forage fed and relation of grain feeding to milk production on family-size commercial dairy farms in the Northeast 1/

Year	Grain fed milk cows		TDN required for milk production	TDN from grain		Percent of grain fed that was purchased	Estimated daily consumption of forage (hay equivalent 2/)
	Per cow	Per 100 pounds of milk		Total	Percent of that required for milk		
	Pounds	Pounds	Pounds	Pounds	Percent	Percent	Pounds
1940	1,900	31.2	1,952	1,425	73.0	70	20.5
1941	2,080	33.1	2,013	1,560	77.4	70	20.0
1942	2,120	32.9	2,061	1,590	77.1	73	20.2
1943	2,180	35.3	1,976	1,635	82.7	75	19.5
1944	2,240	36.9	1,949	1,680	86.2	85	19.1
1945	2,350	37.1	2,024	1,762	87.0	81	19.0
1946	2,270	36.2	2,003	1,702	84.5	75	19.3
1947	2,320	35.2	2,108	1,740	82.0	74	19.6
1948	2,350	36.2	2,177	1,762	85.5	77	19.8
1949	2,480	36.9	2,149	1,860	86.5	71	19.2
1950	2,540	37.0	2,196	1,905	86.8	73	19.2
1951	2,550	37.0	2,208	1,912	86.7	68	19.2

1/ Adapted from U. S. Dept. Agr. AIB 86, Changes in dairy farming in the Northeast, 1930-51. Issued in 1952.

2/ Calculated by difference, estimating the average cow weighing 1,100 pounds and deducting from the total yearly TDN requirement that furnished in the grain fed.



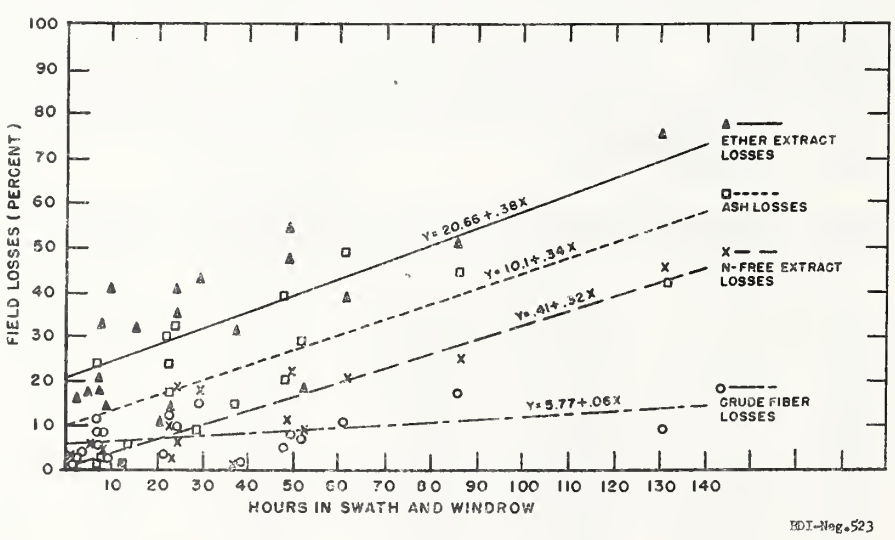


Figure 1.- Relation between time in swath and windrow and field losses of dry matter and feed nutrients in forage